

High Energy Physics - Experiment

Observation of Geo-Neutrinos

Borexino Collaboration

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Geo-neutrinos, electron anti-neutrinos produced in beta decays of naturally occurring radioactive isotopes in the Earth, are a unique direct probe of our planet's interior. We report the first observation of geo-neutrinos, performed with the Borexino detector at Laboratori Nazionali del Gran Sasso. Anti-neutrinos are detected through the neutron inverse beta decay reaction. With a 252.6 ton-yr fiducial exposure after all selection cuts, we detected $9.9^{+4.1}_{-3.4}({}^{+14.6}_{-8.2})$ geo-neutrino events, with errors corresponding to a 68.3%(99.73%) C.L. From the $\ln\{\mathcal{L}\}$ profile, the statistical significance of the Borexino geo-neutrino observation corresponds to a 99.997% C.L. Our measurement of the geo-neutrinos rate is $3.9^{+1.6}_{-1.3}({}^{+5.8}_{-3.2})$ events/(100ton-yr). This measurement rejects the hypothesis of an active geo-reactor in the Earth's core with a power above 3 TW at 95% C.L. The observed prompt positron spectrum above 2.6 MeV is compatible with that expected from european nuclear reactors (mean base line of approximately 1000 km). Our measurement of reactor anti-neutrinos excludes the non-oscillation hypothesis at 99.60% C.L.

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